

This listing of claims replaces all prior versions and listings of claims in this application.

LISTING OF CLAIMS:

1. (Currently Amended) A method for the preparation of a polymer electrolyte electrochemical cell using an electrolyte precursor, said precursor comprising one or more solvents, one or more salts and a polymer which dissolves in the solvent at a first temperature ~~(T_{dissol})~~, T_{dissol} , and which is capable of forming a gel on subsequent cooling following heating to a second temperature ~~(T_{gel})~~, T_{gel} , wherein T_{dissol} being is lower than T_{gel} , which method comprises:

heating the electrolyte precursor to T_{dissol} ;

- (a) optionally cooling the electrolyte precursor;
- (b) incorporating the electrolyte precursor into the electrochemical cell;
- (c) heating the electrochemical cell to T_{gel} ; and
- (d) cooling the polymer electrolyte cell to ambient temperature to bring about gelling of the polymer electrolyte.

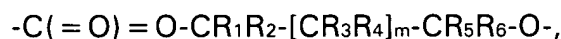
2. (Currently Amended) The A method according to claim 1, in which said polymer is a homopolymer or copolymer selected from the group of monomers consisting of vinyl fluoride, vinylidene fluoride, trifluoroethylene, tetrafluoroethylene and hexafluoropropylene.

3. (Currently Amended) The A method according to claim 1, in which said polymer is a copolymer of vinylidene fluoride and hexafluoropropylene.

4. (Currently Amended) The A method according to claim 3, in which said copolymer of vinylidene fluoride and hexafluoropropylene has a molecular weight in the range ~~50,000-500,000~~, 50,000-500,000 ~~more preferably 100,000-300,000~~, and a weight ratio of vinylidene fluoride and hexafluoropropylene in the range 80:20 to 90:10.

5. (Currently Amended) The A method according to claim 1, in which the electrolyte comprises one or more solvent(s) selected from the ~~groups~~ group consisting of (a) to (e):

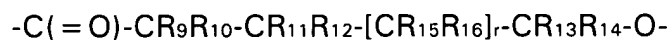
(a) alicyclic carbonates represented by the following general formula:



wherein each of R₁, R₂, R₃, R₄, R₅ and R₆ independently represents hydrogen or a C₁-C₄ alkyl group and m is 0 or 1, ~~preferably ethylene carbonate or propylene carbonate;~~

(b) aliphatic carbonates represented by the general formula R₇[OC(O)]_pOR₈, wherein each of R₇ and R₈ independently represents a C₁-C₄ alkyl group, and p is an integer equal to 1 or 2, ~~preferably dimethyl carbonate or diethyl carbonate;~~

(c) lactones in the form of cyclic esters represented by the general formula:



wherein each of R₉, R₁₀, R₁₁, R₁₂, R₁₃, R₁₄, R₁₅ and R₁₆ independently represents hydrogen or a C₁₋₂ alkyl group and r is 0 or 1, ~~preferably γ -valerolactone and/or γ -butyrolactone;~~

(d) esters represented by the formula R₁₇[C(O)]OR₁₈]_t, wherein each of R₁₇, R₁₈ and R₁₉ independently represents hydrogen or a C_{1-C2} alkyl group, and t is 0 or an integer equal to 1 or 2, ~~preferably an acetate, more preferably (2-methoxy ethyl) acetate or ethyl acetate; and~~

(e) glymes represented by the general formula R₂₀O(R₂₁O)_nR₂₂, in which each of R₂₀ and R₂₂ independently represents a C₁₋₂ alkyl group, R₂₁ is - (CR₂₃R₂₄CR₂₅R₂₆)- wherein each of R₂₃, R₂₄, R₂₅ and R₂₆ independently represents hydrogen or a C_{1-C4} alkyl groups, and n is an integer from 2 to 6, ~~preferably 3, R₂₀ and R₂₂ preferably being methyl groups, R₂₃, R₂₄, R₂₅ and R₂₆ preferably being hydrogen or C_{1-C2} alkyl groups, more preferably hydrogen.~~

6. (Currently Amended) The A method according to claim 1, in which the electrolyte comprises one or more salts selected from the group consisting of alkali metal or ammonium salts of ClO₄, CF₃SO₃, AsF₆, PF₆ ~~or~~ and BF₄, ~~preferably LiPF₆ and LiBF₄.~~

7. (Currently Amended) The A method according to claim 1, in which the electrolyte comprises solvent(s), salt(s) and ~~polymer(s)~~ polymer in the compositional range from 63:25:12 to 94:5:1 percent of the total weight of the electrolyte system, ~~preferably in the compositional range from 70:20:10 to 90:8:2 percent of the total weight of the electrolyte system, more preferably in the compositional range from 75:17:8 to 88:8:4 percent of the total weight of the electrolyte system.~~

8. (Currently Amended) The A method according to claim 1 in which the electrolyte is confined in a separator consisting of a porous structure made of a polymer, ~~preferably of polyethylene, polypropylene, polycarbonate or cellulose.~~

9. (Currently Amended) The A method according to claim 8, in which the separator has a woven or non-woven structure having a pore size in the range of 10 x 10 nm to 1 x 1 mm.

10. (Currently Amended) The A method according to claim 8, in which the separator has a thickness of 10-100 μ m, ~~preferably 10-25 μ m.~~

11. (Currently Amended) The A method according to claim 1, in which the electrochemical cell has a negative electrode structure comprising one or more compounds selected from the group consisting of graphite, coke, mesocarbon microbeads, carbon black, aluminum, silicon ~~or~~ and tin, ~~preferably graphite, mesocarbon microbeads, coke or carbon black, more preferably graphite or mesocarbon microbeads,~~ and a positive electrode structure comprising one or more compounds selected from the group consisting of lithium manganese oxides, lithium cobalt oxides and lithium nickel oxides, ~~preferably lithium manganese oxides, more preferably lithium manganese oxide LiMn_2O_4 of spinel structure.~~

12. (Currently Amended) The A method according to claim 1, in which the dissolution temperature T_{dissol} is in the range 45-80°C, ~~preferably 60-80°C, more preferably 65-75°C,~~ and the gelling temperature T_{gel} is in the range 75-100°C, ~~preferably 80-90°C,~~ with the proviso, that T_{gel} should be higher than T_{dissol} .

13. (Currently Amended) The A method according to claim 1, in which the electrochemical cell is wound prior to electrolyte impregnation.

14. (Currently Amended) The A method according to claim 1, in which the electrolyte incorporation is carried out by pouring or injection.

15. (Currently Amended) The A method according to claim 1, in which the electrodes display such a porosity which is such as to allow diffusion of a relatively solvent-rich electrolyte phase into the pores of the electrodes, leaving a relatively polymer-rich electrolyte phase in the volume between the electrodes.

16. (Currently Amended) The A method according to claim 1 wherein the gap between electrode laminates of the electrochemical cell is smaller than at least the largest polymer particles so that the electrolyte in the vicinity of the edge of the laminate and outside the laminate contains a larger amount of polymer than the electrolyte between the electrodes.

17. (Currently Amended) An electrochemical cell having a negative electrode structure comprising one or more compounds selected from the group consisting of graphite, coke and mesocarbon microbeads, and a positive electrode structure comprising one or more compounds selected from the group consisting of lithium manganese oxides, lithium cobalt oxides and lithium nickel oxides, ~~preferably lithium manganese oxide~~, and a gelled polymer electrolyte, 1-12% by weight, ~~preferably 4-8% by weight~~, of the total weight of the electrolyte being said polymer, ~~which is selected from the group of homopolymers and copolymers~~ wherein said polymer is a homopolymer or copolymer selected from the group of monomers consisting of vinyl fluoride, vinylidene fluoride, trifluoroethylene,

tetrafluoroethylene and hexafluoropropylene, preferably a copolymer of vinylidene fluoride and hexafluoropropylene, said electrochemical cell being obtained by or being obtainable by a method as claimed in claim 1 comprising

(a) heating an electrolyte precursor, comprising one or more solvents, one or more salts and a polymer which dissolves in the solvent at a first temperature, T_{dissol} , and which is capable of forming a gel on subsequent cooling following heating to a second temperature, T_{gel} , to the temperature T_{dissol} , wherein T_{dissol} is lower than T_{gel} ;

(b) cooling the electrolyte precursor

(c) incorporating the electrolyte precursor into the electrochemical cell;

(d) heating the cell to T_{gel} ; and

(e) cooling the polymer electrochemical cell to ambient temperature to bring about gelling of the polymer electrolyte.

18. (New) The method according to claim 4, wherein the copolymer of vinylidene fluoride and hexafluoropropylene has a molecular weight in the range of 100,000-300,000.

19. (New) The method according to claim 5, wherein the electrolyte comprises one or more solvents selected from the group consisting of

(a) alicyclic carbonates selected from the group consisting of ethylene carbonate and propylene carbonate;

(b) aliphatic carbonates selected from the group consisting of dimethyl carbonate and diethyl carbonate;

(c) lactones selected from the group consisting of γ -valerolactone and γ -butyrolactone;

(d) esters selected from the group consisting of (2-methoxyethylacetate) and ethylacetate;

(e) glymes wherein R₂₀ and R₂₂ are methyl and R₂₃, R₂₄, R₂₅ and R₂₆ are hydrogen.

20. (New) The method according to claim 7, wherein the electrolyte comprises solvent(s), salt(s) and polymer in the compositional range 75:17:8 to 88:8:4 percent of the total weight of the electrolyte system.

21. (New) The method according to claim 8, wherein the separator consists of a porous structure made of a polymer selected from the group consisting of polyethylene, polypropylene, polycarbonate, and cellulose.

22. (New) The method according to claim 10, wherein the thickness is 10-25 μm .

23. (New) The method according to claim 11, wherein the negative electrode structure comprises one or more compounds selected from the group consisting of graphite and mesocarbon microbeads; and the positive electrode structure comprises LiMn₂O₄ of spinel structure.

24. The method according to claim 12, wherein T_{dissol} is in the range 65-75°C, and T_{gel} is in the range of 80-90°C.

25. The method according to claim 6, wherein the electrolyte comprises one or more salts selected from the group consisting of LiPF₆ and LiBF₄.

26. The electrochemical cell according to claim 17, wherein the positive electrode structure comprises lithium magnesium oxide.

27. The electrochemical cell according to claim 17, wherein the polymer is a copolymer of vinylidene fluoride and hexafluoropropylene.

28. The electrochemical cell according to claim 17, wherein the polymer is 4-8% by weight of the total weight of the electrolyte.